Why Is It So Hard to Tell If Dredging Bothers Winter Flounder (Pseudopleuronectes americanus)?

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Sacramento
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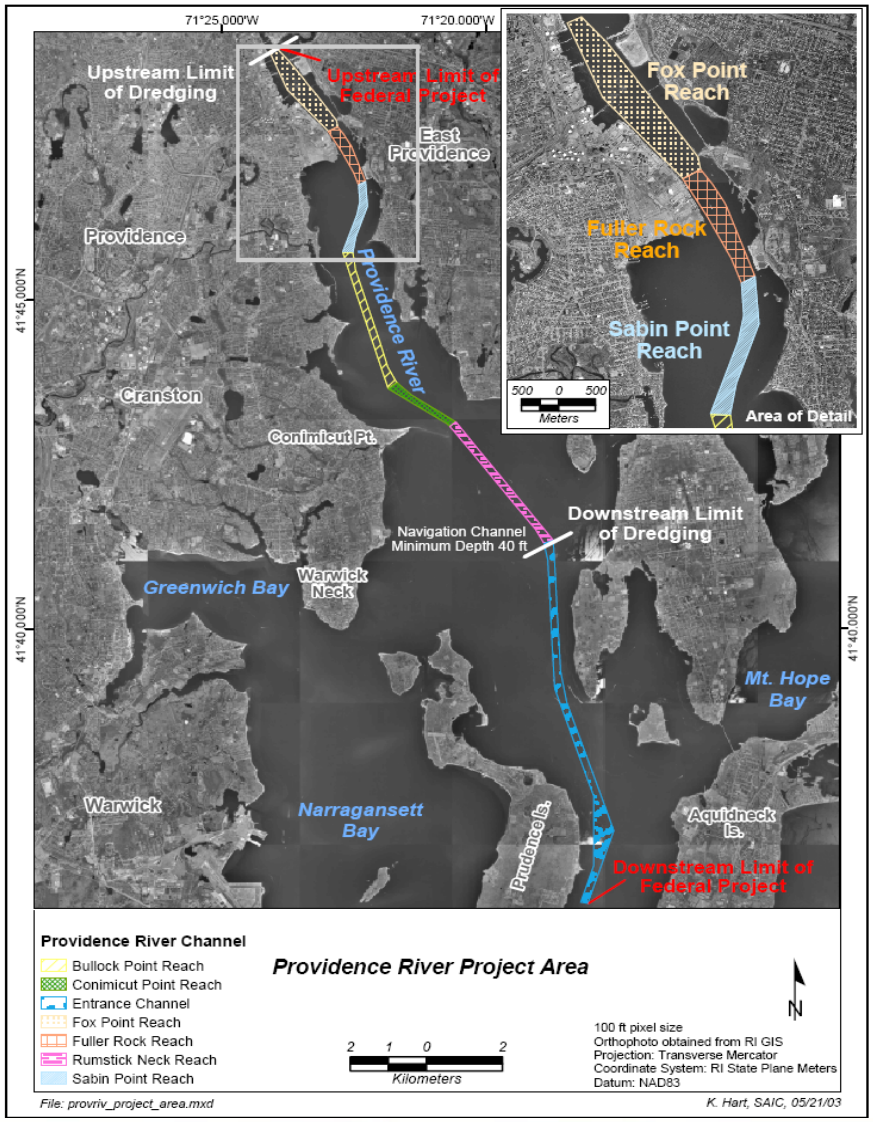
What I hope to Do Today

- Introduce the Providence River dredging project.
- Talk about “risk assessment”
- Talk about winter flounder eggs.
- Talk about resuspension in the Providence River
- Put it all together.

Providence River

- Problem: Where to put the dredged material?
- Solution: Dirty stuff in CAD cell, clean stuff goes off-shore.
- “Ecological effects?”
- “No problem!” (ACOE)
- “No dredging in Feb, Mar, and April!” (USFWS, DEM)
- Dredging Sequencing is the answer.

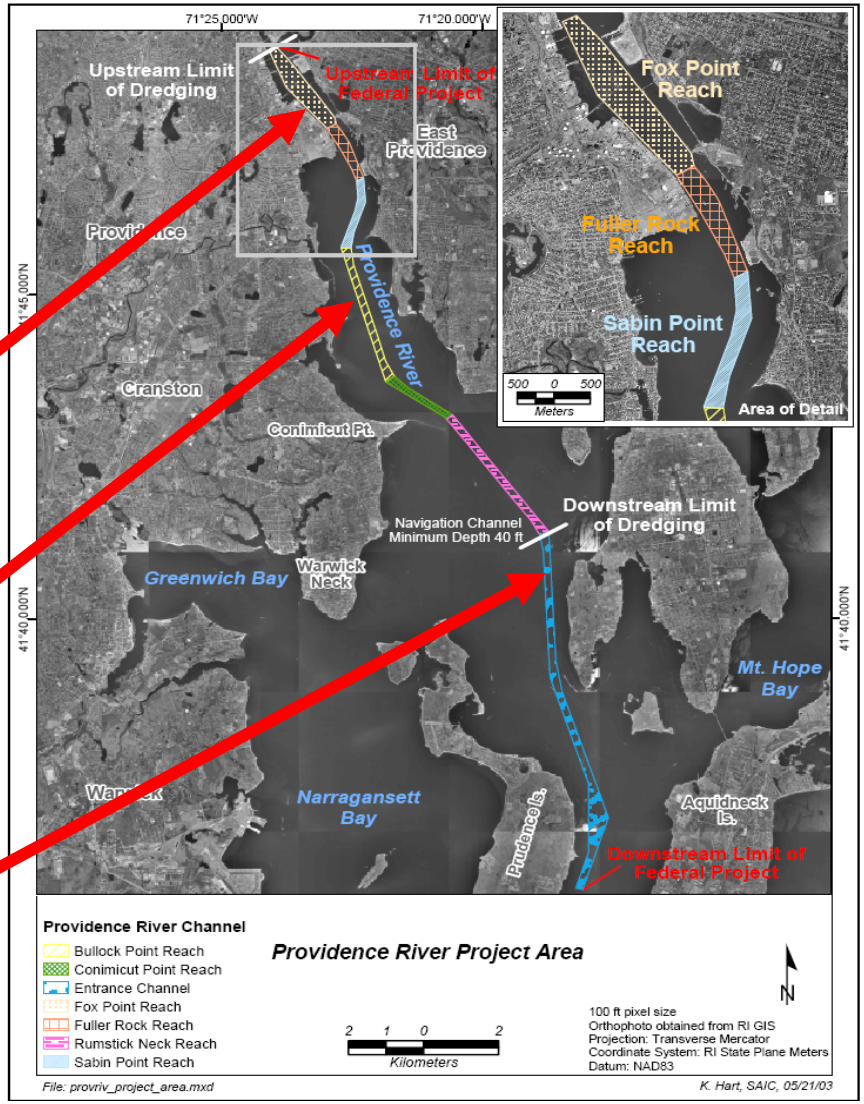


Dredging Sequencing

No dredging Feb 1 - April 30

Dredge any time

Dredge March/April



Why Worry About Winter Flounder?

- The Winter Flounder is recreationally and commercially important.
- Populations have declined steadily over the past 20 years and are at an all time low.
- The species is considered to be overexploited and threatened.
- Winter Flounder eggs are vulnerable to burial from dredging operations.

Why are Winter Flounder eggs Vulnerable to Burial?

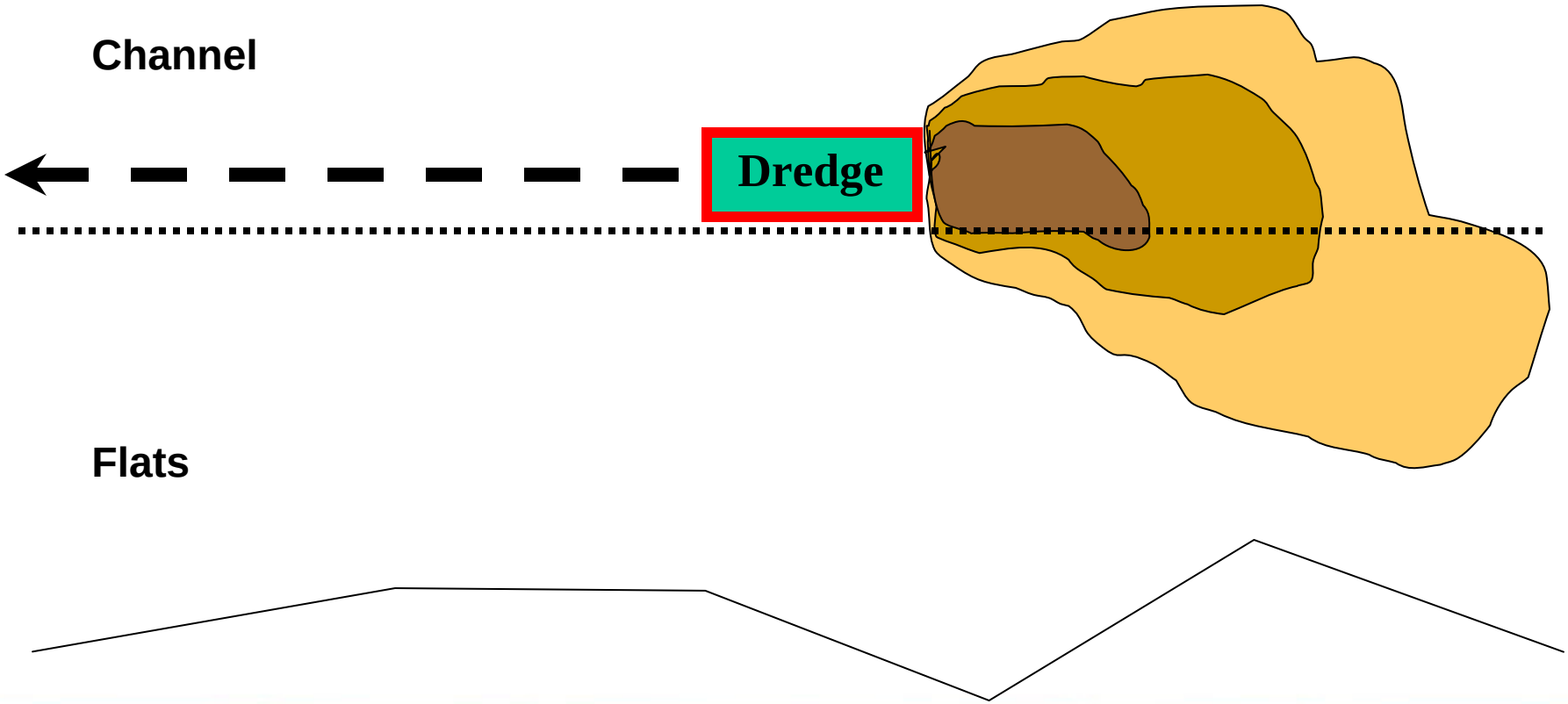
- Winter Flounder eggs are vulnerable to burial because:
- Eggs are demersal and stick together in clusters on the substrate surface.
- Spawning occurs in the late winter.
- Hatching takes between 15-18 days at a temperature of 2.8°- 3.3°C.

So, What's the Problem?

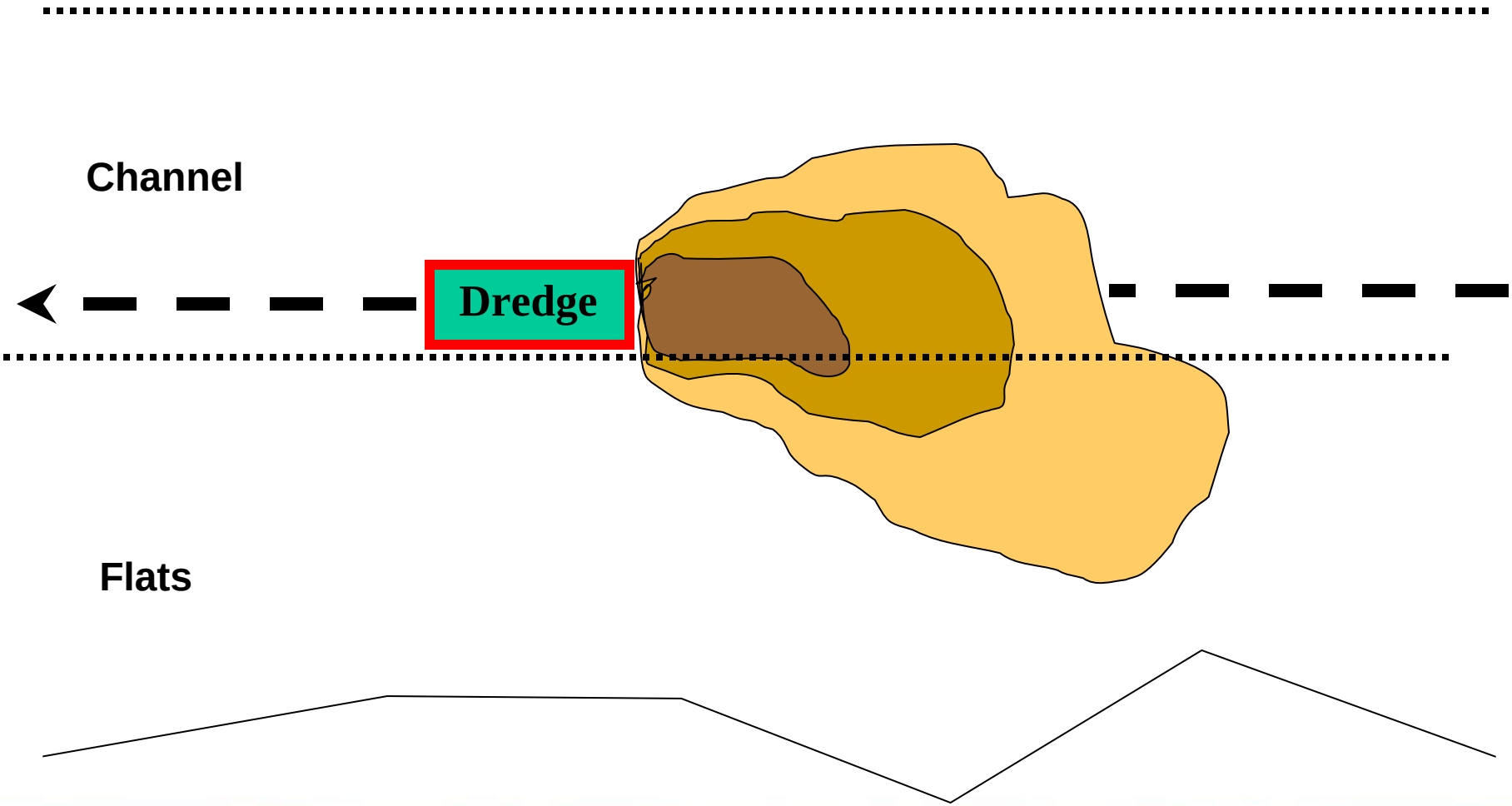
- Conventional wisdom is that sediment deposition of ½ of an egg diameter (approx. 0.5 mm) causes a reduction in viable hatch.
- To reduce risk to eggs dredging "sequencing" and/or expensive seasonal constraints on dredging are sometimes employed (e.g.; NY/NJ, Boston, Providence).
- Problem: There are very few data to back up the conventional wisdom.

Dredge Plume

"Apron of Death"
Or "Sediment Blanket"



Dredge Plume



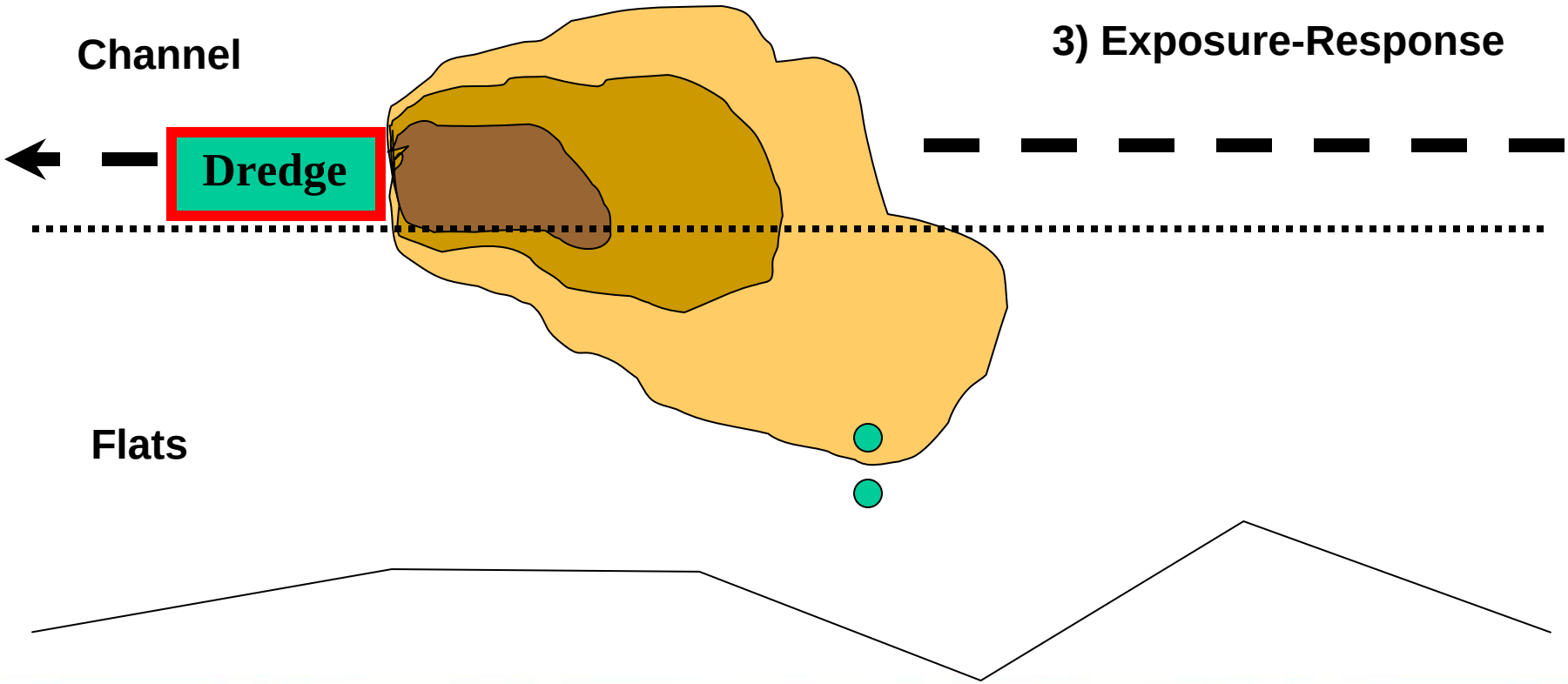
Dredge Plume Effects on Flounder?

Need to Know:

1) Extent of plume

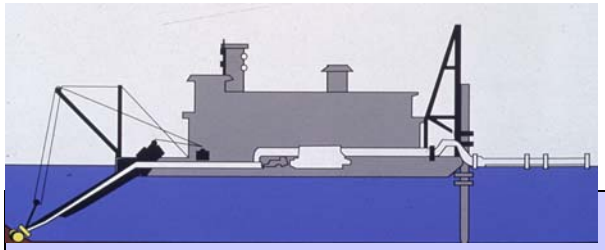
2) Location of Spawning

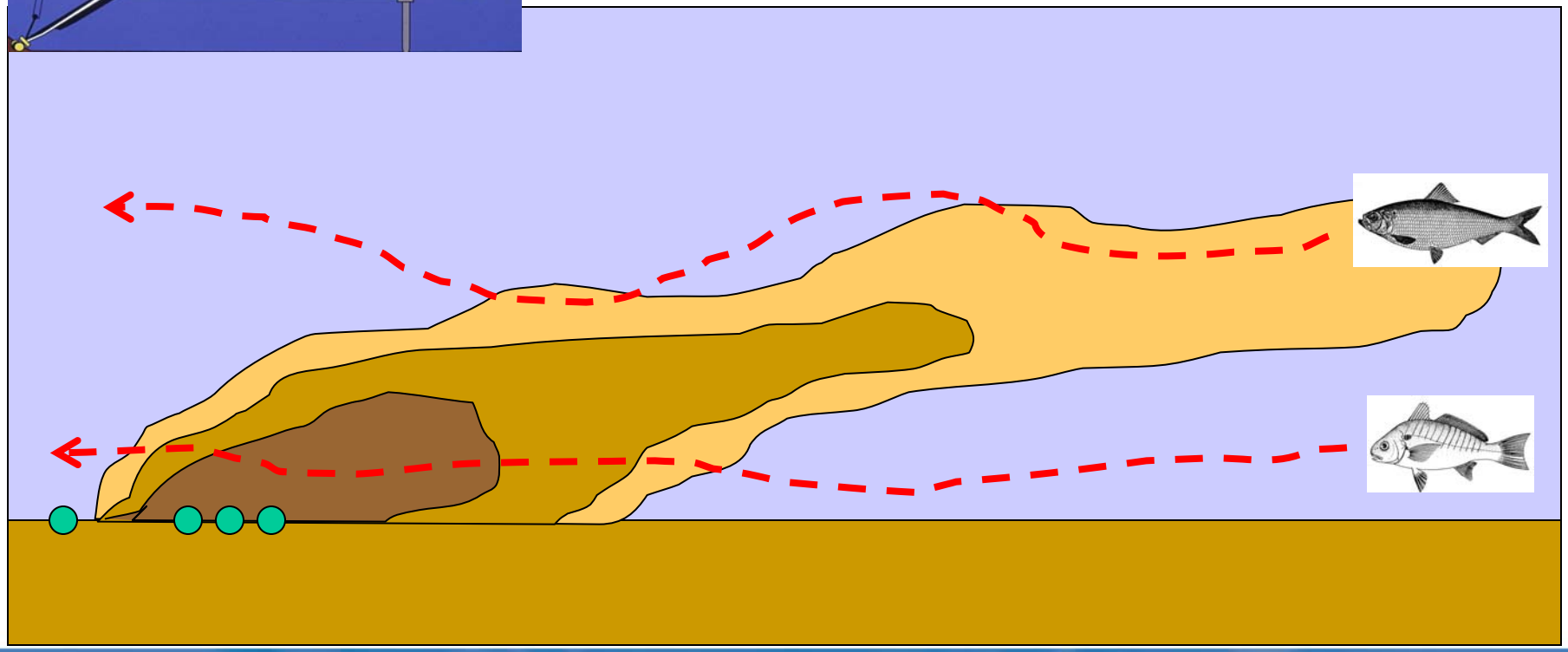
3) Exposure-Response



Estimate of Risk

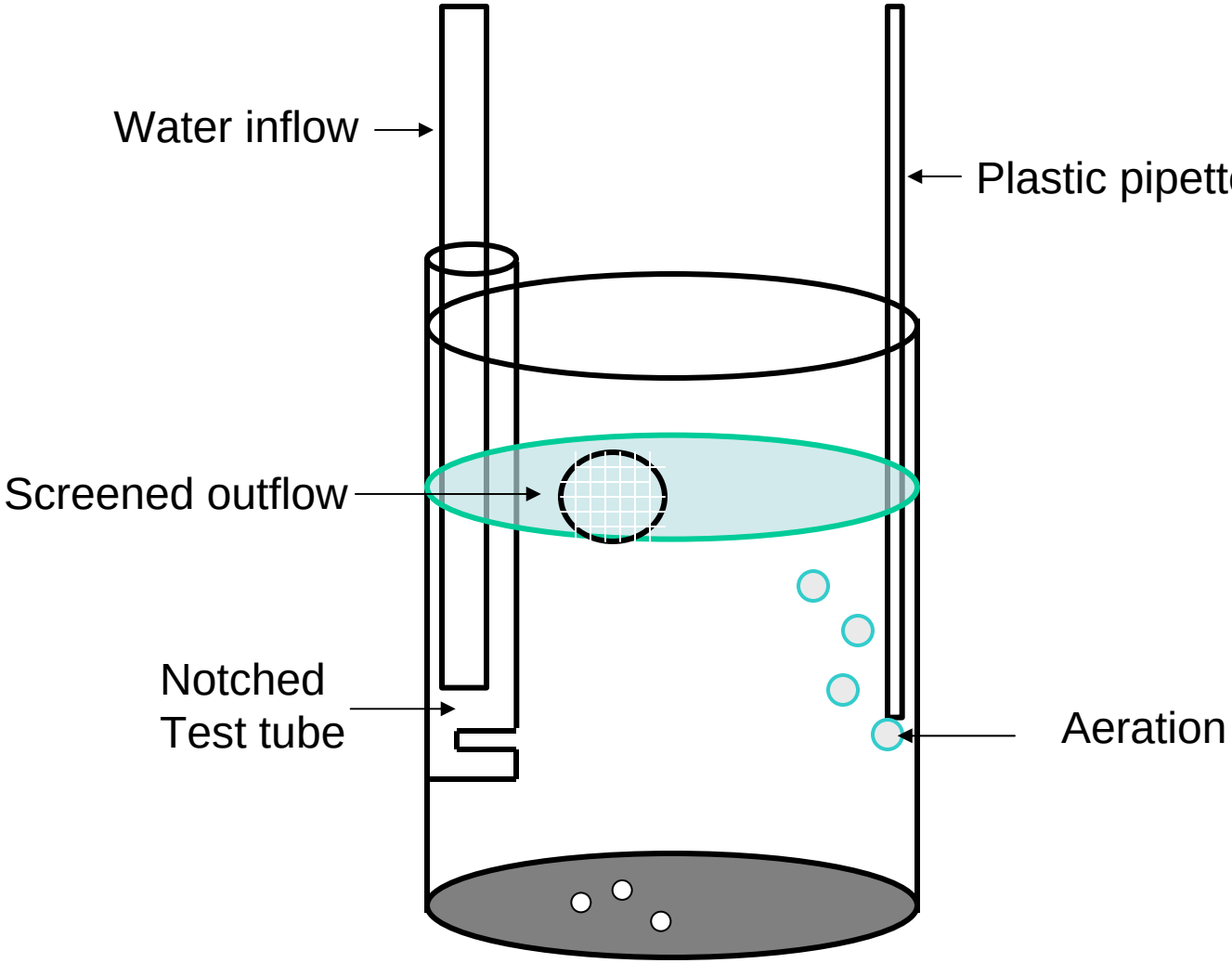
Combine: Concentration, Exposure, and Effects





Research Question:

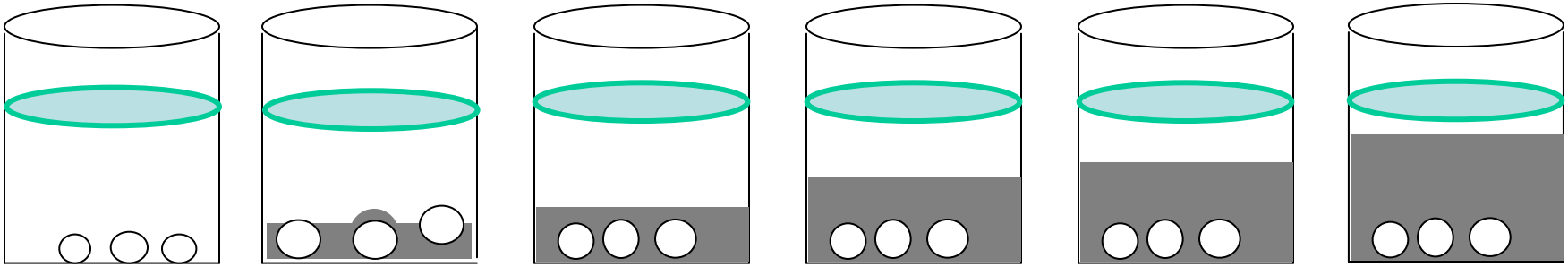
What effect does sediment burial have on the hatching success of winter flounder eggs?



Exposure Beakers for Winter Flounder Burial Experiments

Exposure Beakers

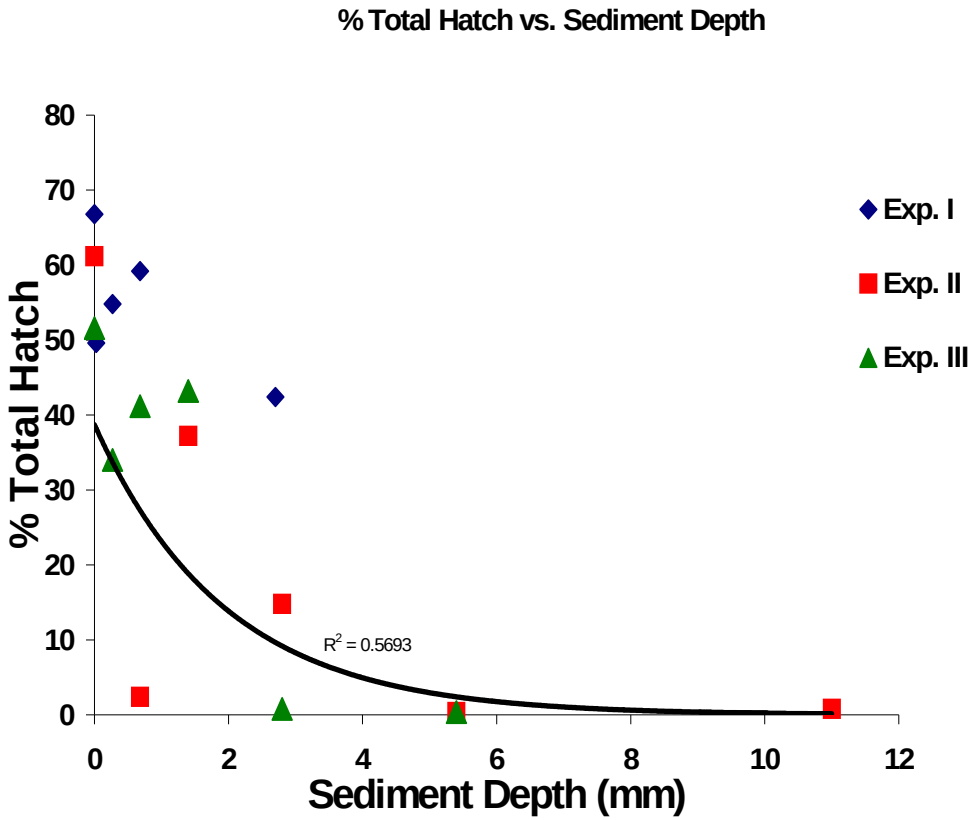
Experimental design for second experiment



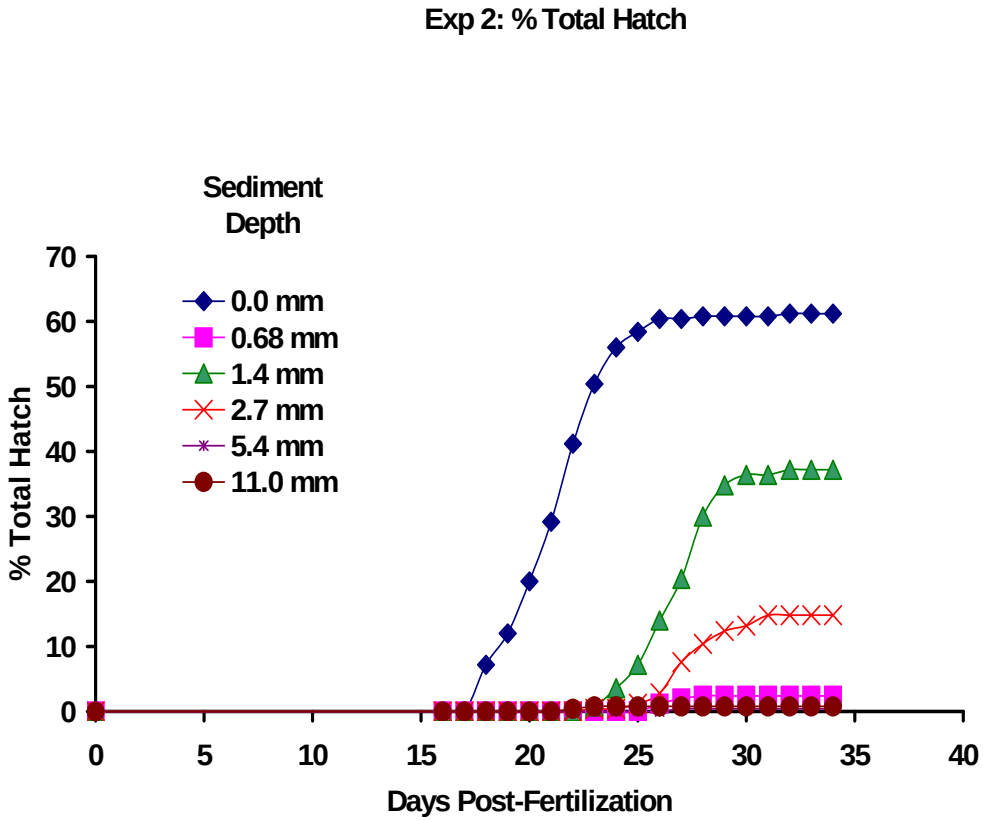
(Drawing obviously not to scale)

% Total Hatch vs. Sediment Depth

All Experiments Combined



Cumulative % Total Hatch by Day



Why is Delayed Hatching a Problem?

- The longer it takes to hatch, the deeper you can get buried.
- Delayed hatching may make juveniles more vulnerable to predation.
  - Warmer winter temperatures lead to lower recruitment.
  - Increased predation has been indicated as a possible cause.

The Flounder and the Shrimp

- In cold years flounder recruit before shrimp become active.
- In warm years the shrimp are waiting when the flounder hit the bottom.
- Any delay of hatching may thus lead to increased predation.

Conclusions: Laboratory Egg Burial Experiments

- Winter flounder hatch rate can be reduced by as little as 1.1 mm burial in clean, muddy sediment. All treatments greater than 2.8 mm burial had almost no hatch.
- Winter flounder hatch may be delayed by less than 1.0 mm burial in clean, muddy sediment.
- Delay of hatch may be a problem for winter flounder.

How do you know where winter flounder eggs are?

- Drag bottom with and epibenthic sled and collect eggs.
- Guess (Use info from other estuaries)
- Look for newly-hatched larvae

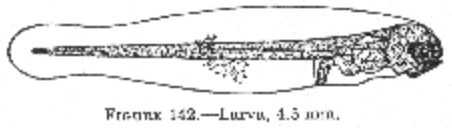
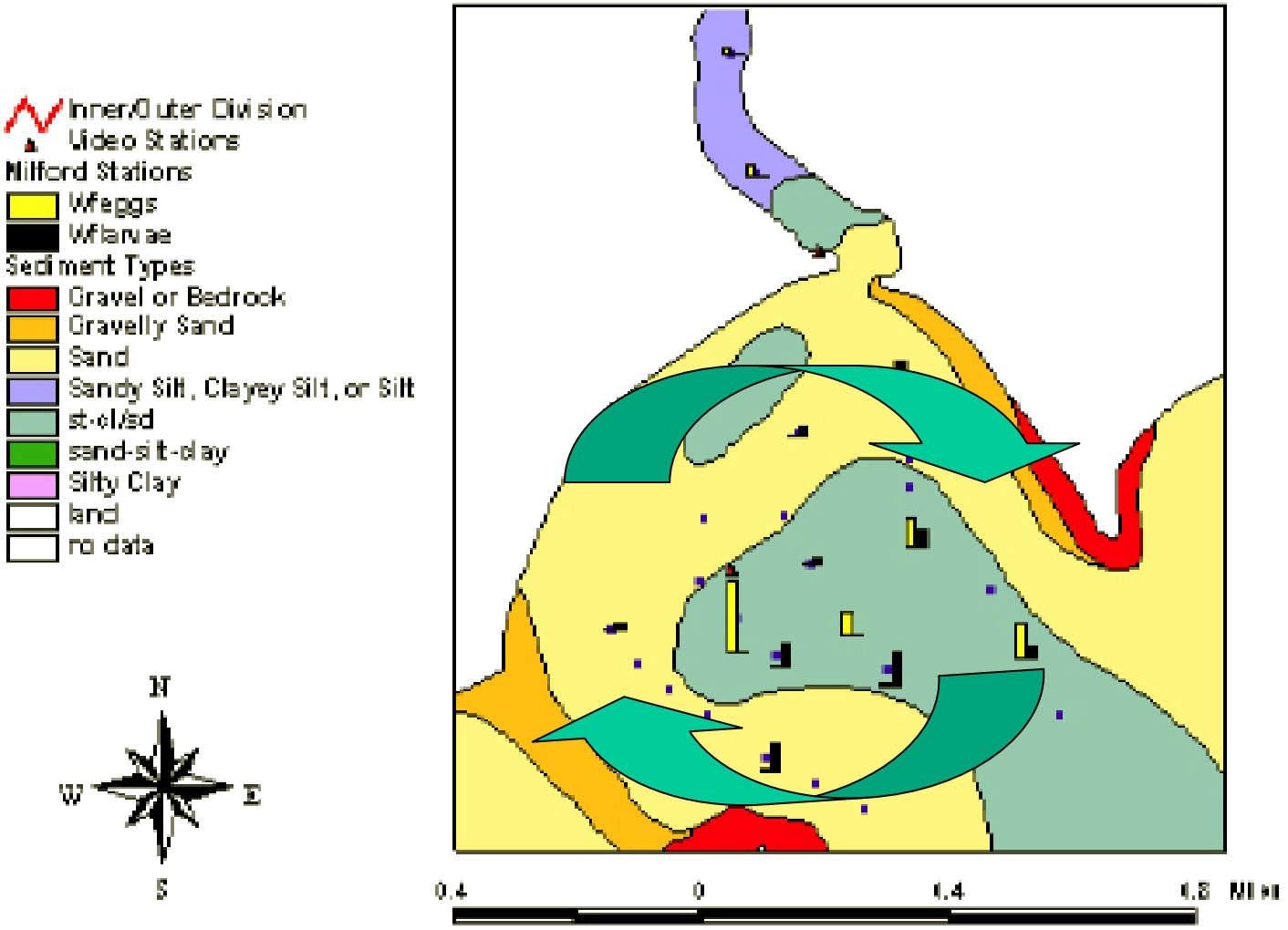
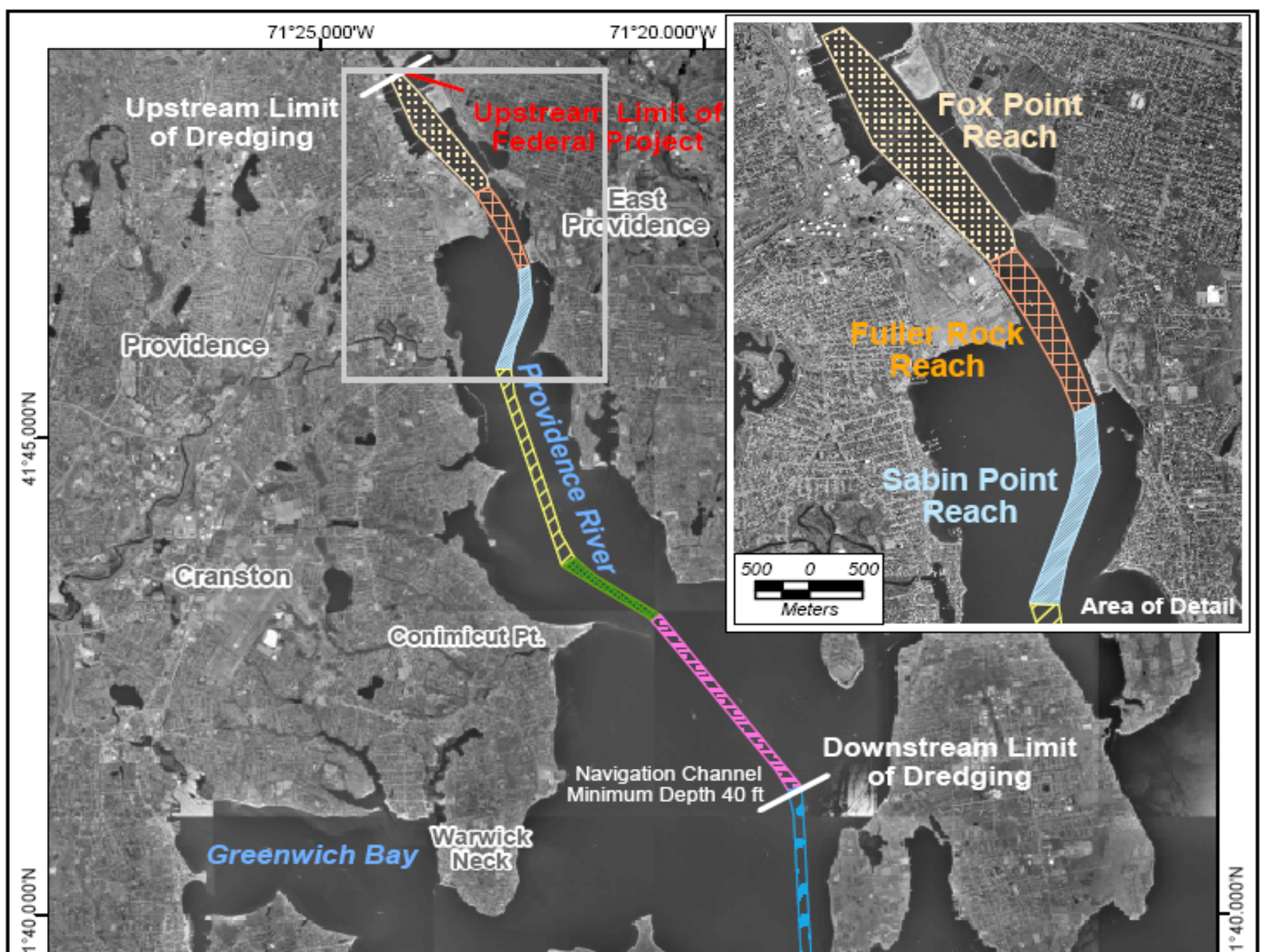


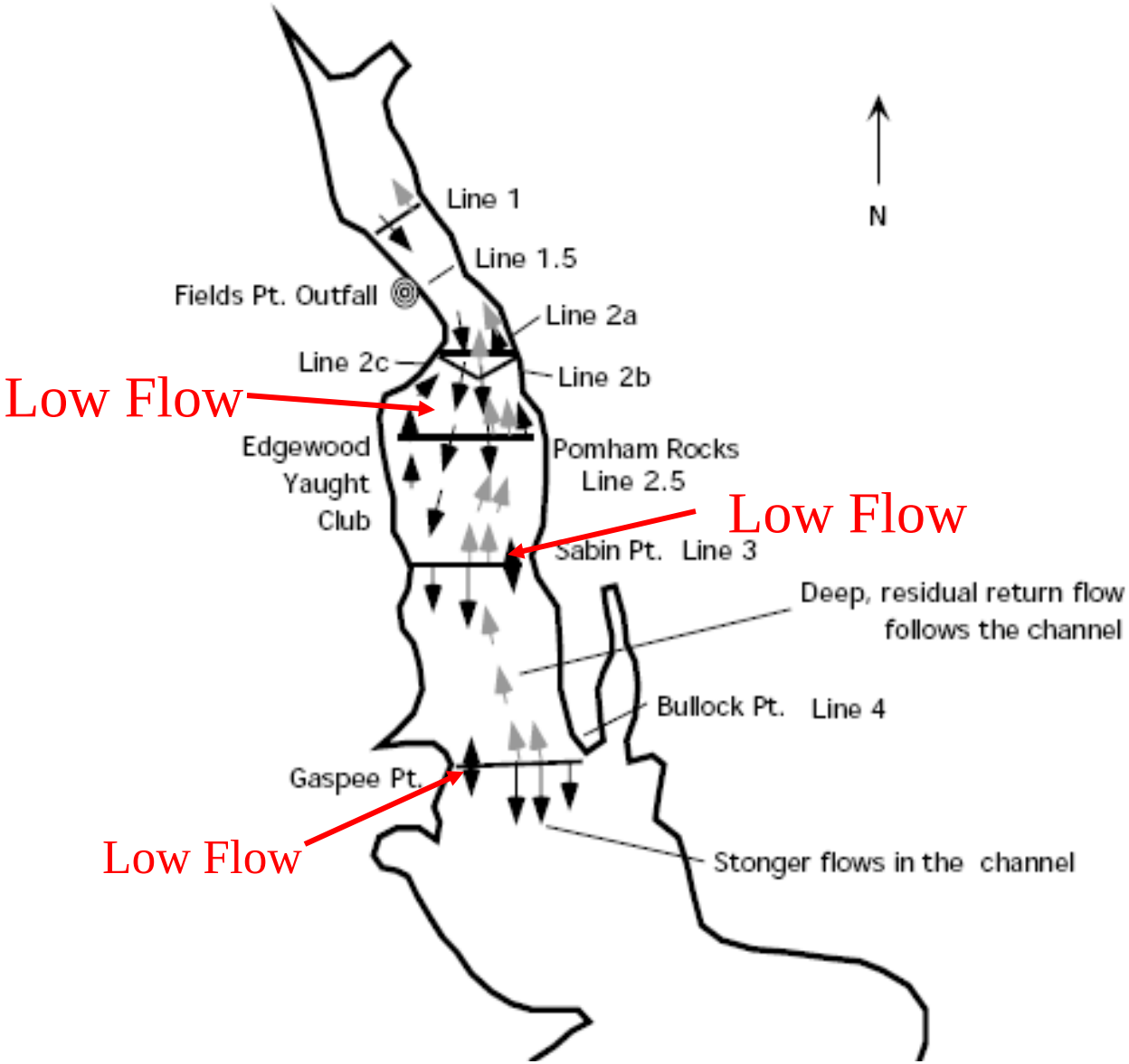
FIGURE 142.—Larva, 4.5 mm.

Milford Harbor



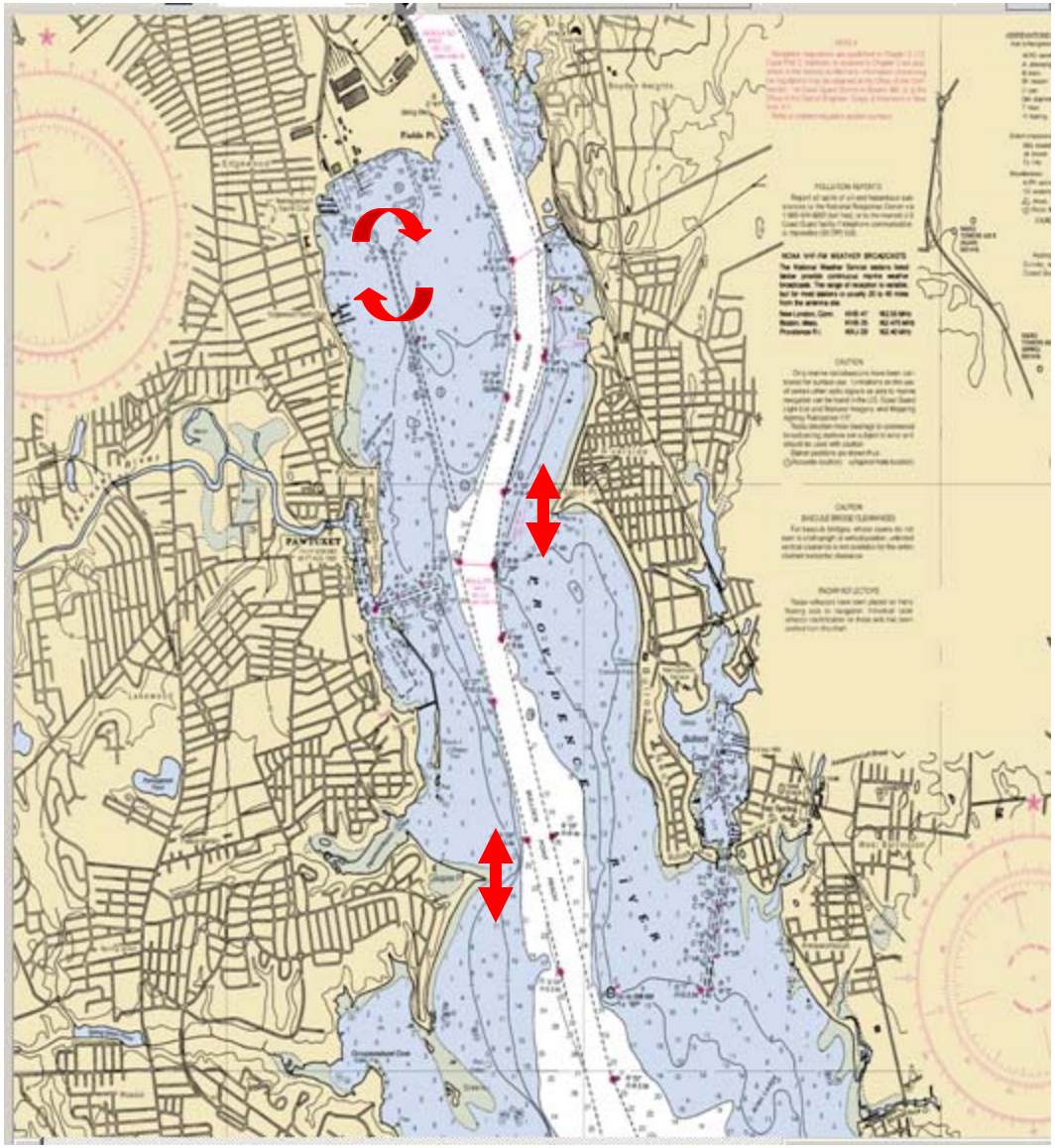
After Schultz et al., 2007


71°25.000'W
71°20.000'W
41°45.000'N
41°40.000'N
Upstream Limit of Dredging
Upstream Limit of Federal Project
East Providence
Providence
Providence River
Cranston
Conimicut Pt.
Navigation Channel Minimum Depth 40 ft
Downstream Limit of Dredging
Greenwich Bay
Warwick Neck
Fox Point Reach
Fuller Rock Reach
Sabin Point Reach
500 0 500
Meters
Area of Detail



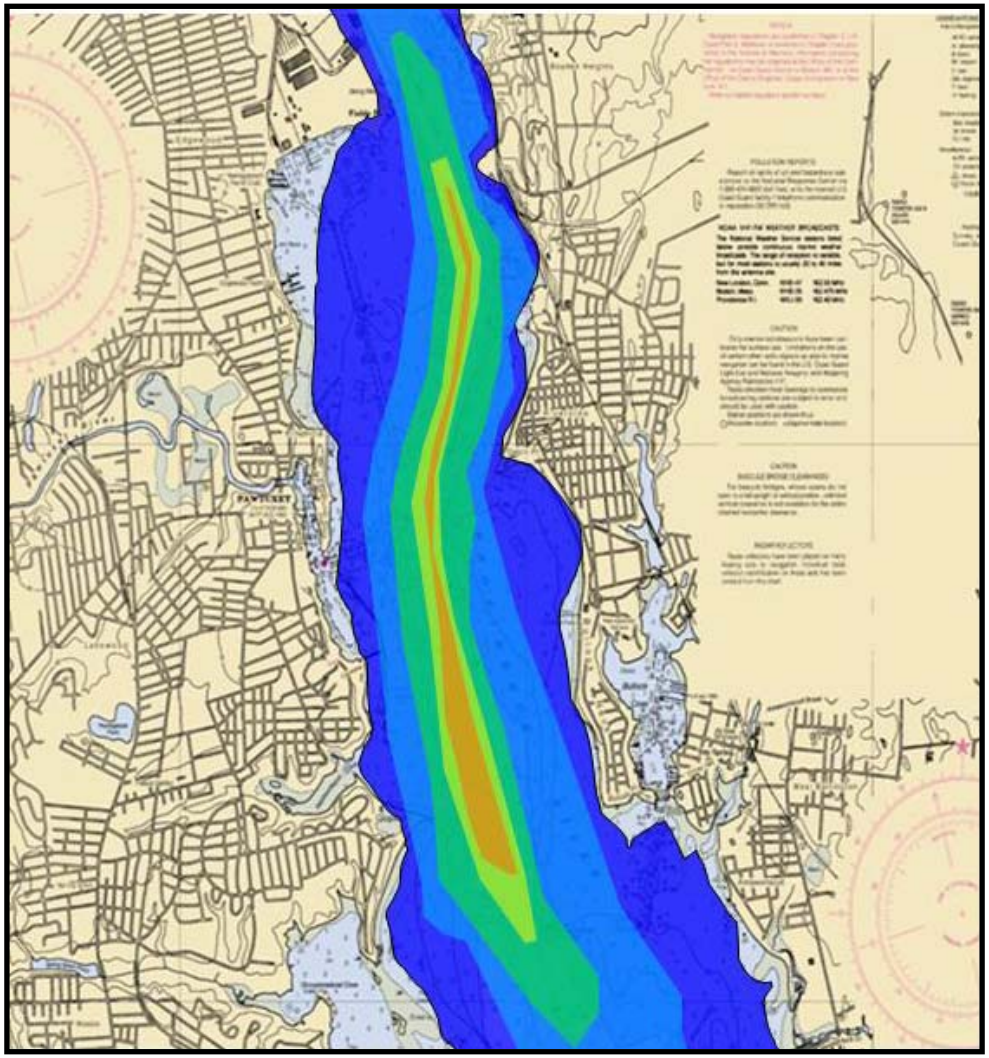
Circulation patterns in Upper Narragansett Bay

After Kincaid, 2003



Potential low current areas in Narragansett Bay

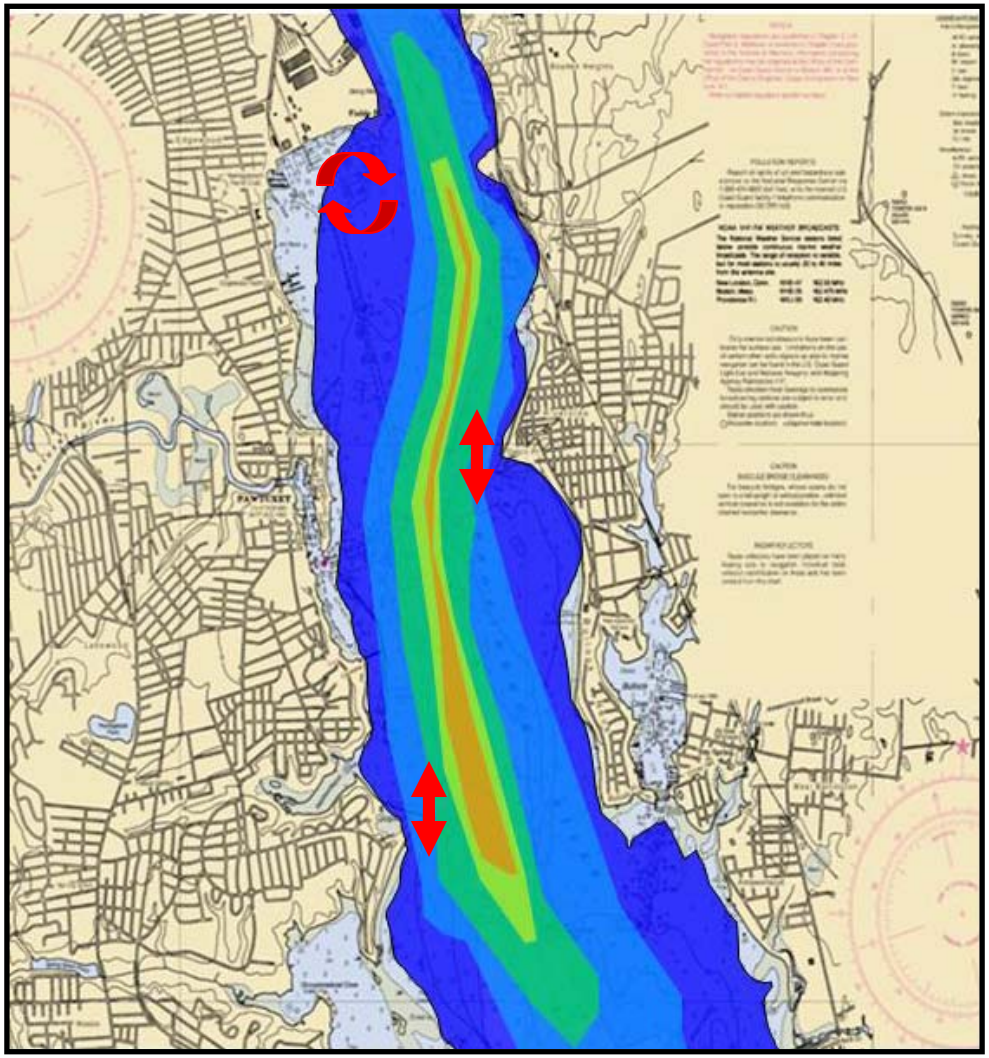
Hypothetical Deposition of sediment



Deposition (mm)

- 0.0
- 1.0
- 2.0
- 3.0
- Above 3.0

Hypothetical Overlap of Deposition and Eggs



Deposition (mm)

- 0.0
- 1.0
- 2.0
- 3.0
- Above 3.0

What We Still Do Not Know

- Exactly what depth of sediment causes problems for winter flounder.
- Exactly where the flounder spawn.
- What the meaningful deposition rate from dredging is in winter flounder spawning areas.
- What risk that deposition poses to winter flounder eggs.


Any
Questions?

Doug's Device

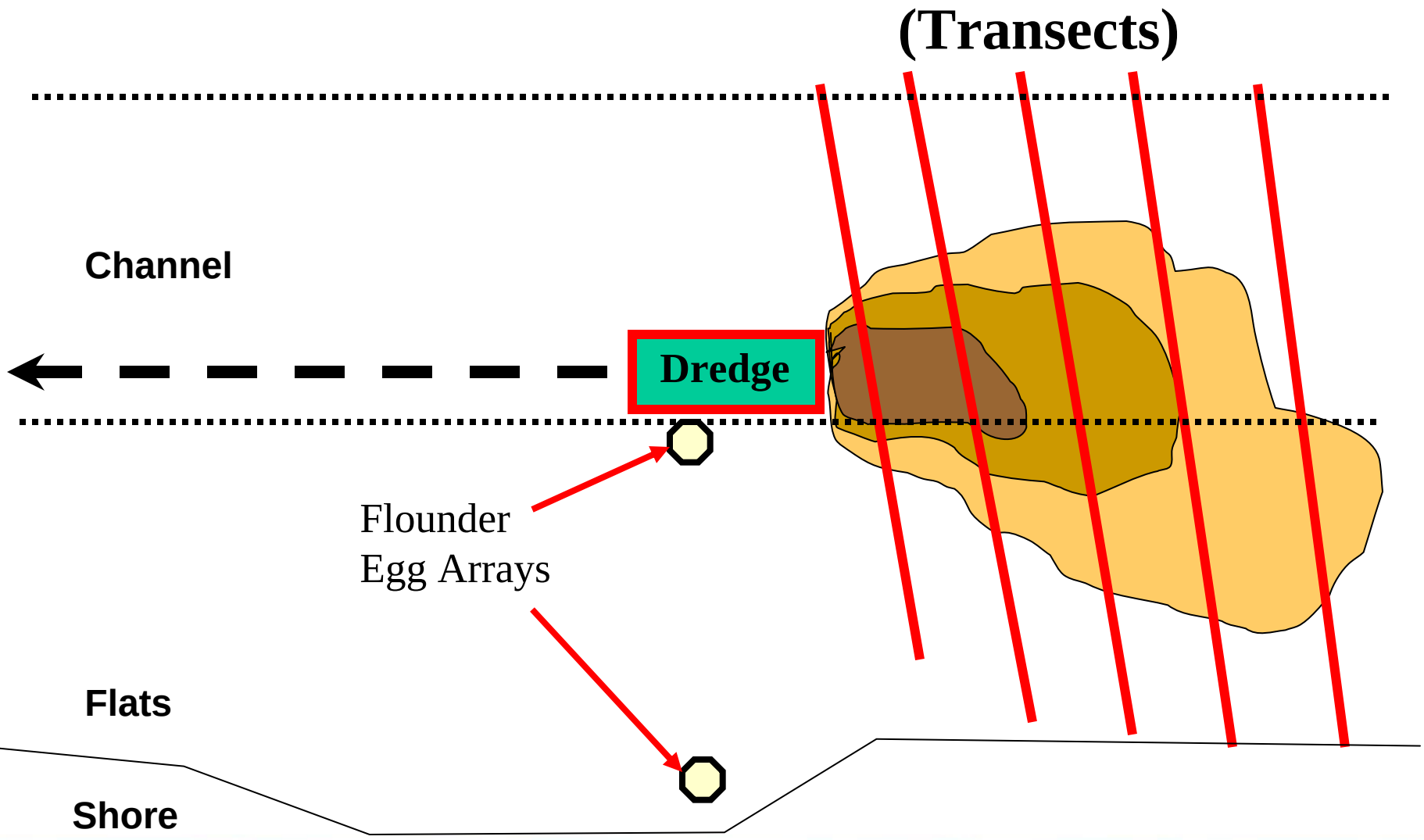
Hint 1: Doug's Boat

Doug's Boat (2)

Doug's Boat (3)

Field Efforts

Wide Area Tidal Stage Plume Characterizations



Dredging/ Disposal Sequencing

Figure 7-2. Potential Dredging Sequences for the Providence River Dredging Project

Priority/	Constraint		April Start	August Start	September Start	January Start
		Aug		Fox Point		
Minimal Impacts		Sep		Fox Point	Fuller Rock	
		Oct		Fuller Rock	Fuller Rock	
		Nov		Fuller Rock	Fox Point	
		Dec		Fuller Rock	Fox Point	
		Jan		Conimicut Point	Fox Point	Fox Point
1) Avoid	2) Avoid Bullock Pt to	Feb		Sabin Point	Sabin Point	Sabin Point
north of	Cominicut Pt. +3,500 ft	Mar		Sabin Point	Sabin Point	Sabin Point
Fields Point	3) Dredge Rumstick Neck	Apr	Rumstick Neck	Rumstick Neck	Rumstick Neck	Rumstick Neck
		May	Fox Point	Bullock Point	Fox Point	Fox Point
4) Avoid Sabin Point to		Jun	Fox Point	Fox Point	Fox Point	Fox Point
Conimicut Point		Jul	Fox Point	Fox Point	Fox Point	Fox Point
		Aug	Conimicut Point	Fox Point	Conimicut Point	Fox Point
Minimal Impacts		Sep	Bullock Point-Lower	Fox Point	Bullock Point	Fuller Rock
		Oct	Fuller Rock	Fox Point	Bullock Point	Fuller Rock
		Nov	Fuller Rock	Fox Point	Fox Point	Fox Point
		Dec	Fuller Rock	Bullock Point	Fox Point	Fox Point
		Jan	Fox Point	Fuller Rock -Cap	Fuller Rock -Cap	Fox Point
1) Avoid	2) Avoid Bullock Pt to	Feb	Bullock Point - Upper		Fuller Rock - Lower	Bullock Point-Upper
north of	Cominicut Pt. +3,500 ft	Mar	Sabin Point			Fuller Rock - Lower
Fields Point	3) Dredge Rumstick Neck	Apr	Sabin Point			Conimicut Point
		May	Fox Point			Bullock Point
4) Avoid Sabin Point to		Jun	Fox Point			Fuller Rock -Cap
Conimicut Point		Jul	Fox Point			
		Aug	Fox Point			
Minimal Impacts		Sep	Fuller Rock -Cap			